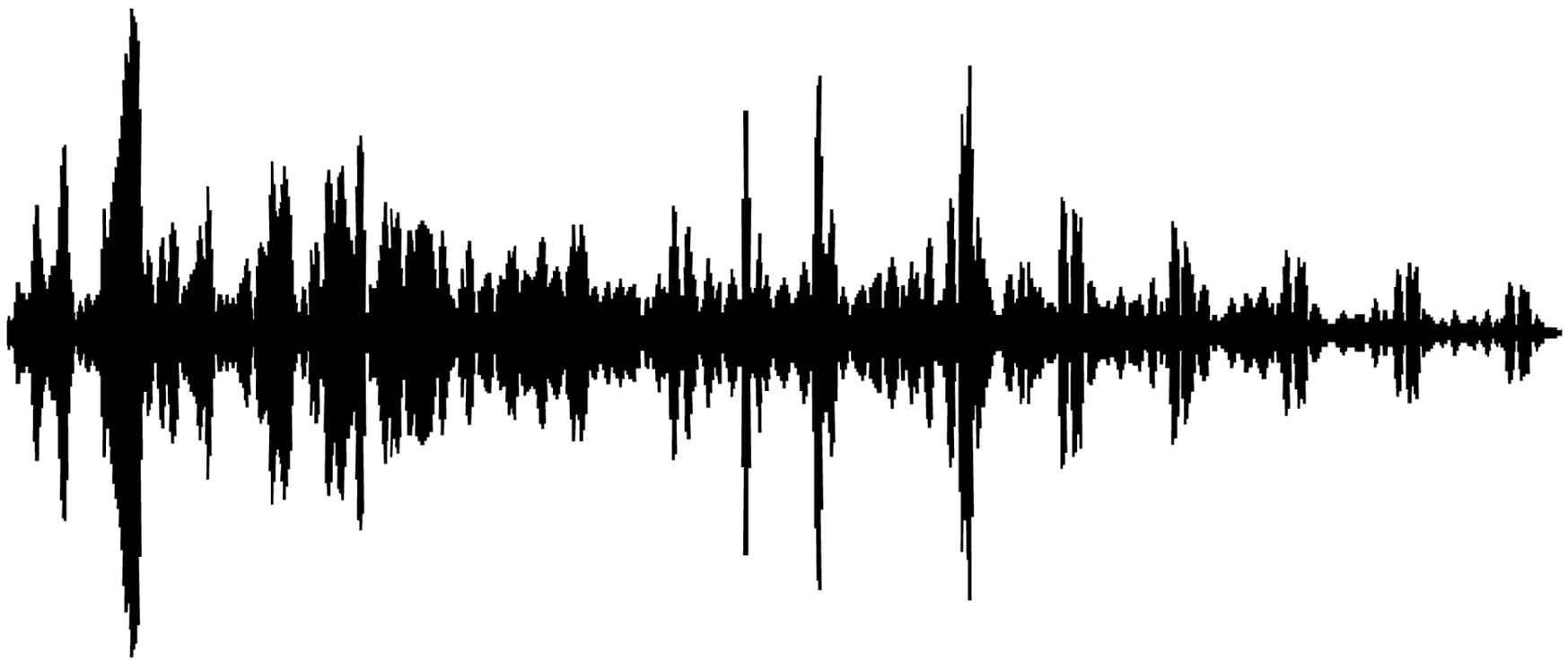
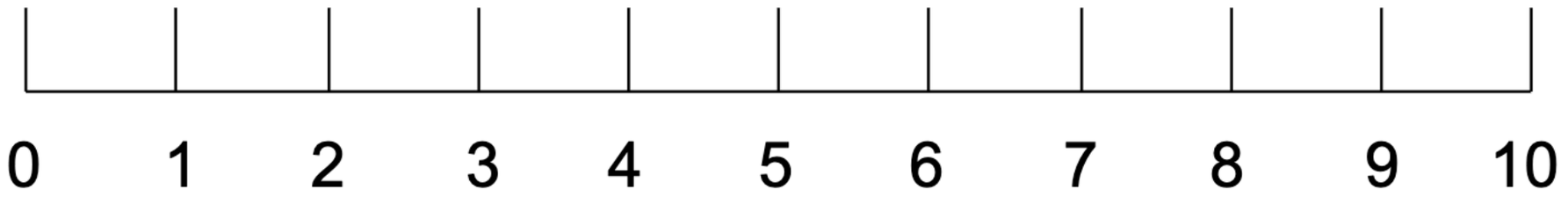


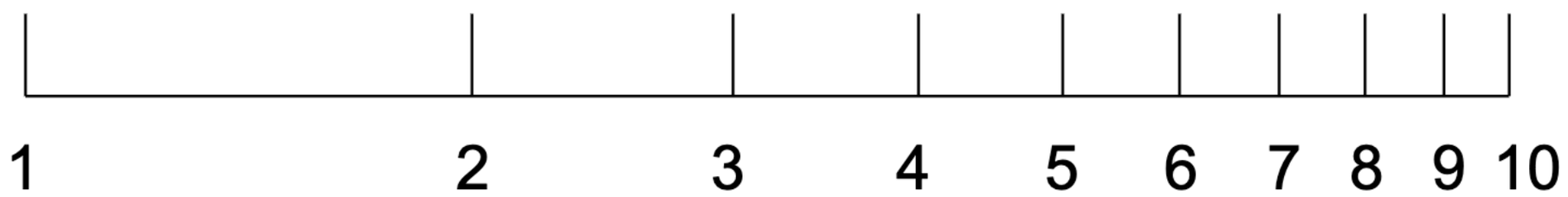
SOUND

WEEK 1

LOG SCALE



Linear scale



Logarithmic scale

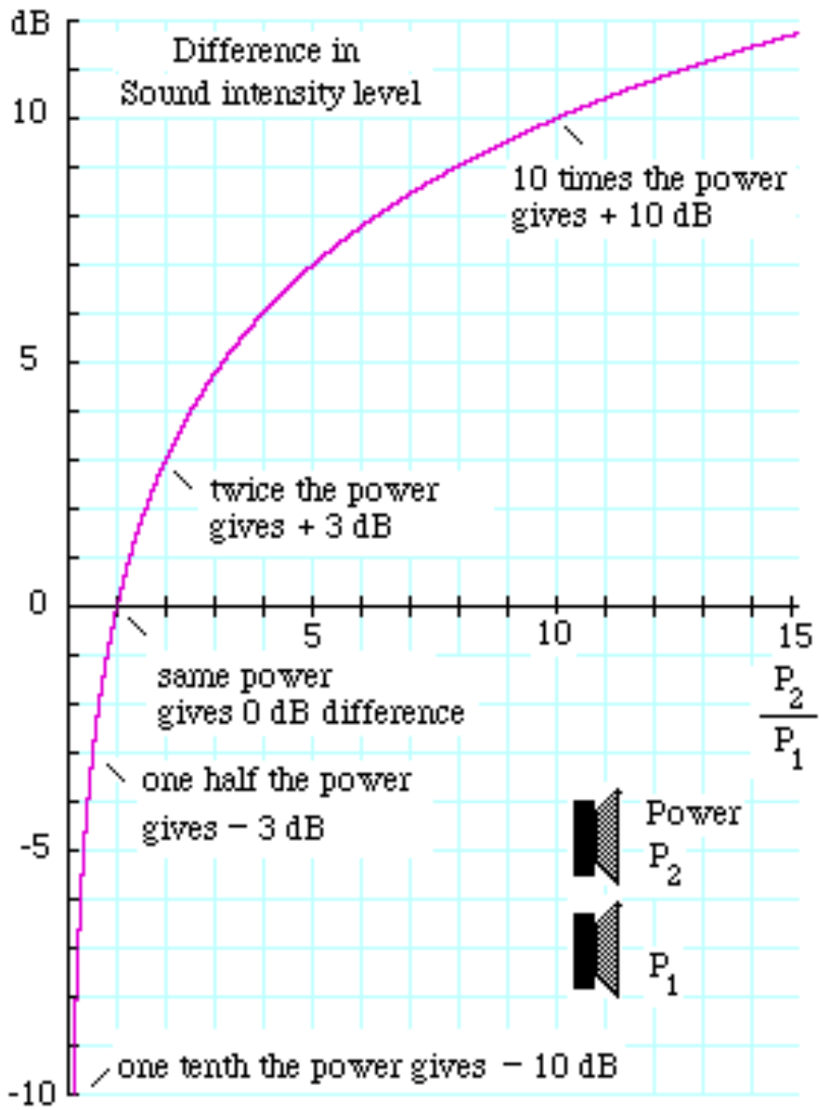
LOG SCALE

- *Frequency* and *Amplitude* of sound are non-linear

- Human *ear response spans* sounds over a *large range* frequencies and levels

- ***logarithmic scale == expresses large magnitude jumps well***

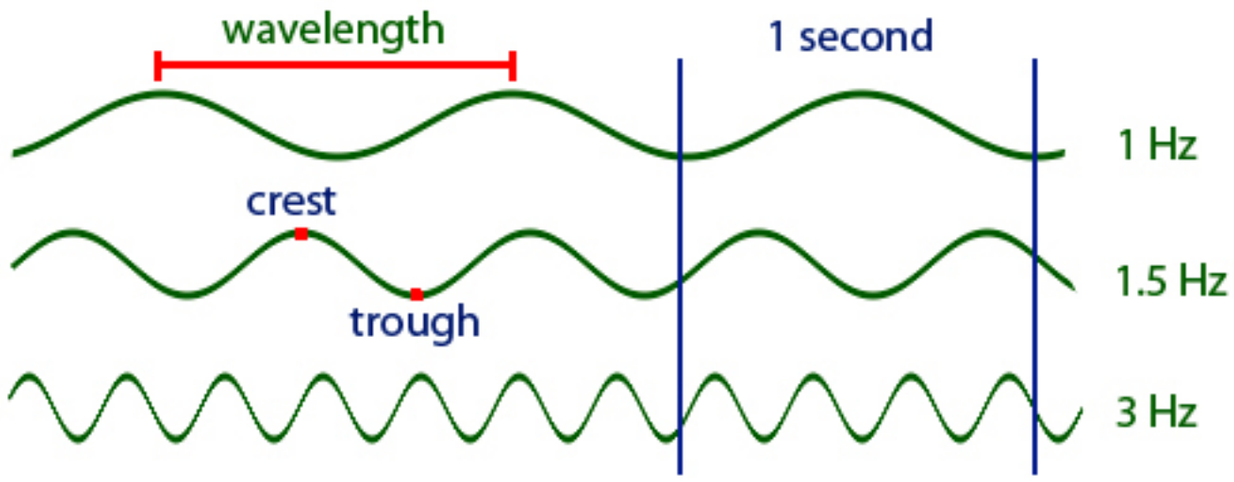
LOG SCALE



- Logarithms are inverse of exponential function
- magnitude in dB = $\log_{10}(P_2/P_1)$
- ***3dB increase* = twice the loudness**
- ***3dB decrease* = half the loudness**
- Explore log math as a project separate from music production

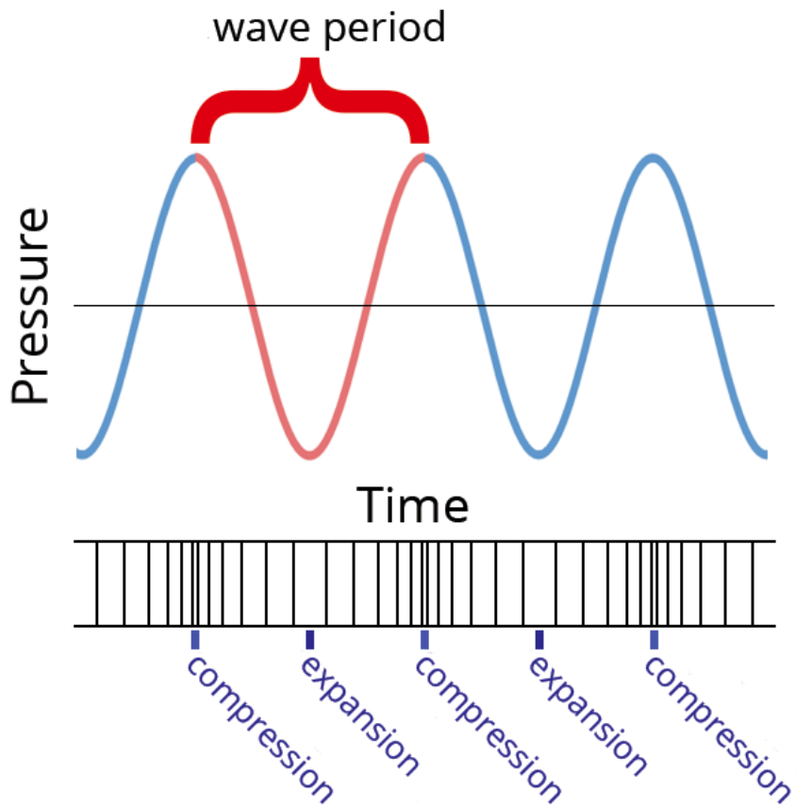
WAVE

- A wave is a type of *oscillation*
- Has two characteristics
  - *Frequency*
  - *Amplitude*

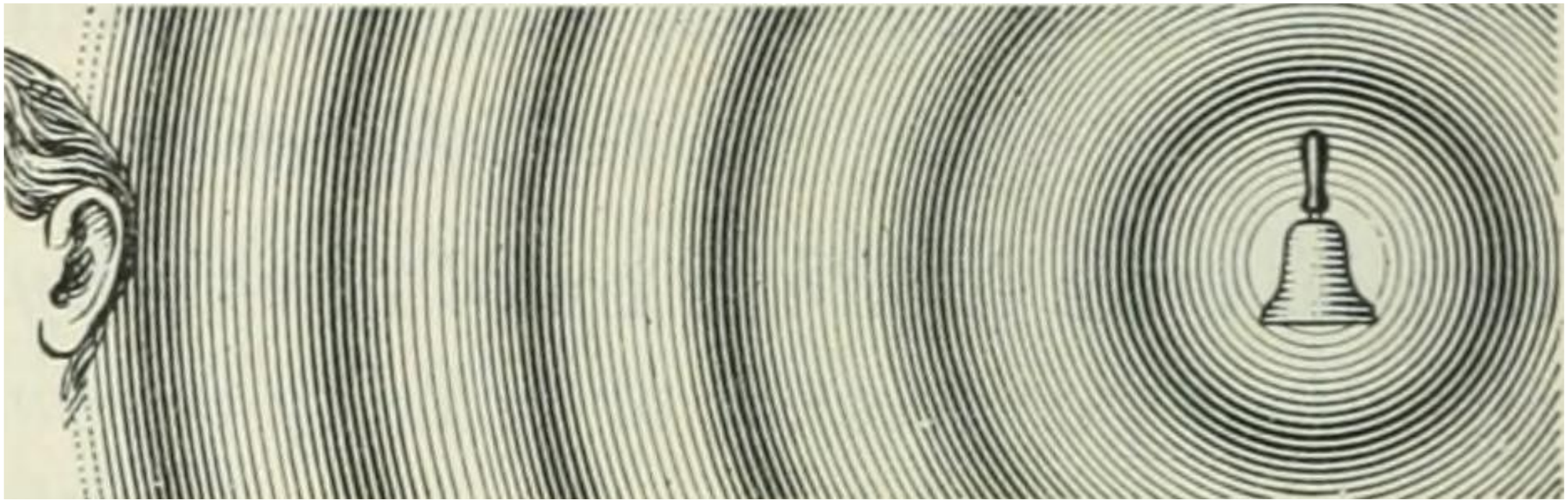


SOUND WAVE

- Composed of ***Compressions*** and ***Rarefactions***
  - Of the medium itself
- No sound in empty spaces
  - Speed varies among mediums



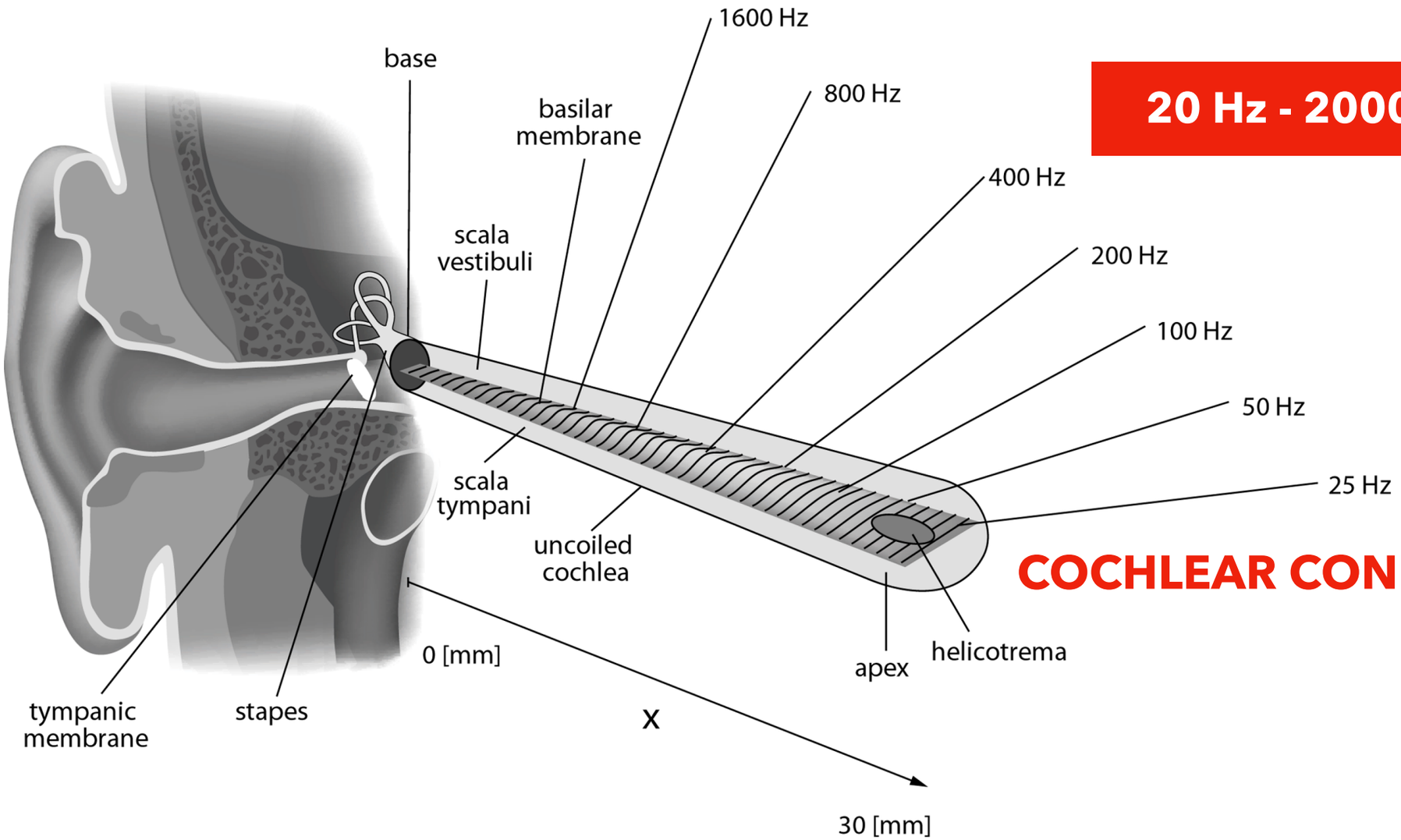
SOUND WAVE



- ***Compressions*** and ***Rarefactions***
    - From ***source*** to ***transducer***

HEARING

FREQUENCY RANGE

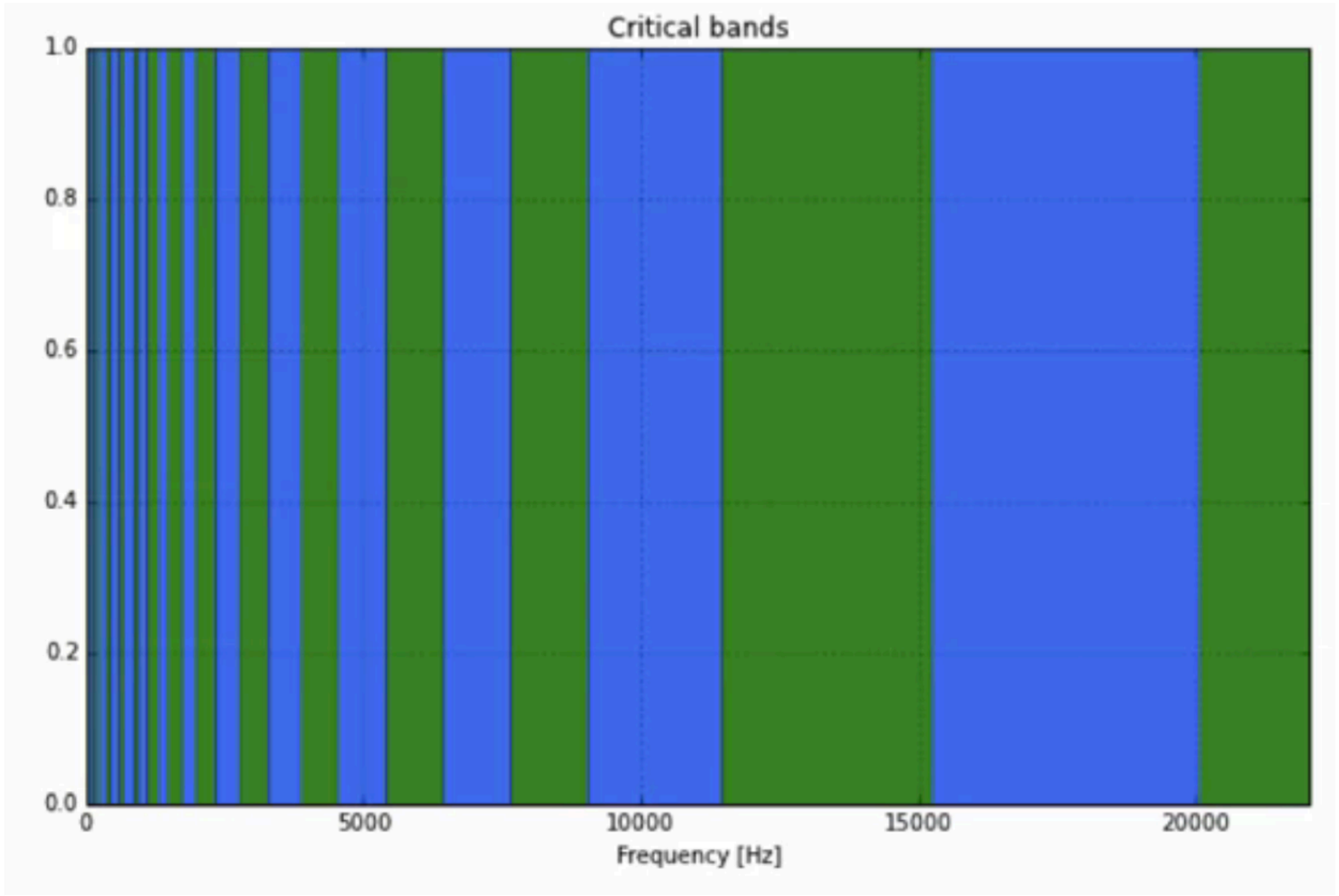


20 Hz - 20000 Hz

COCHLEAR CONE - SOUND PRISM (UNCOILED)

HEARING

24 BAND HUMAN HEARING SPLITS MODEL



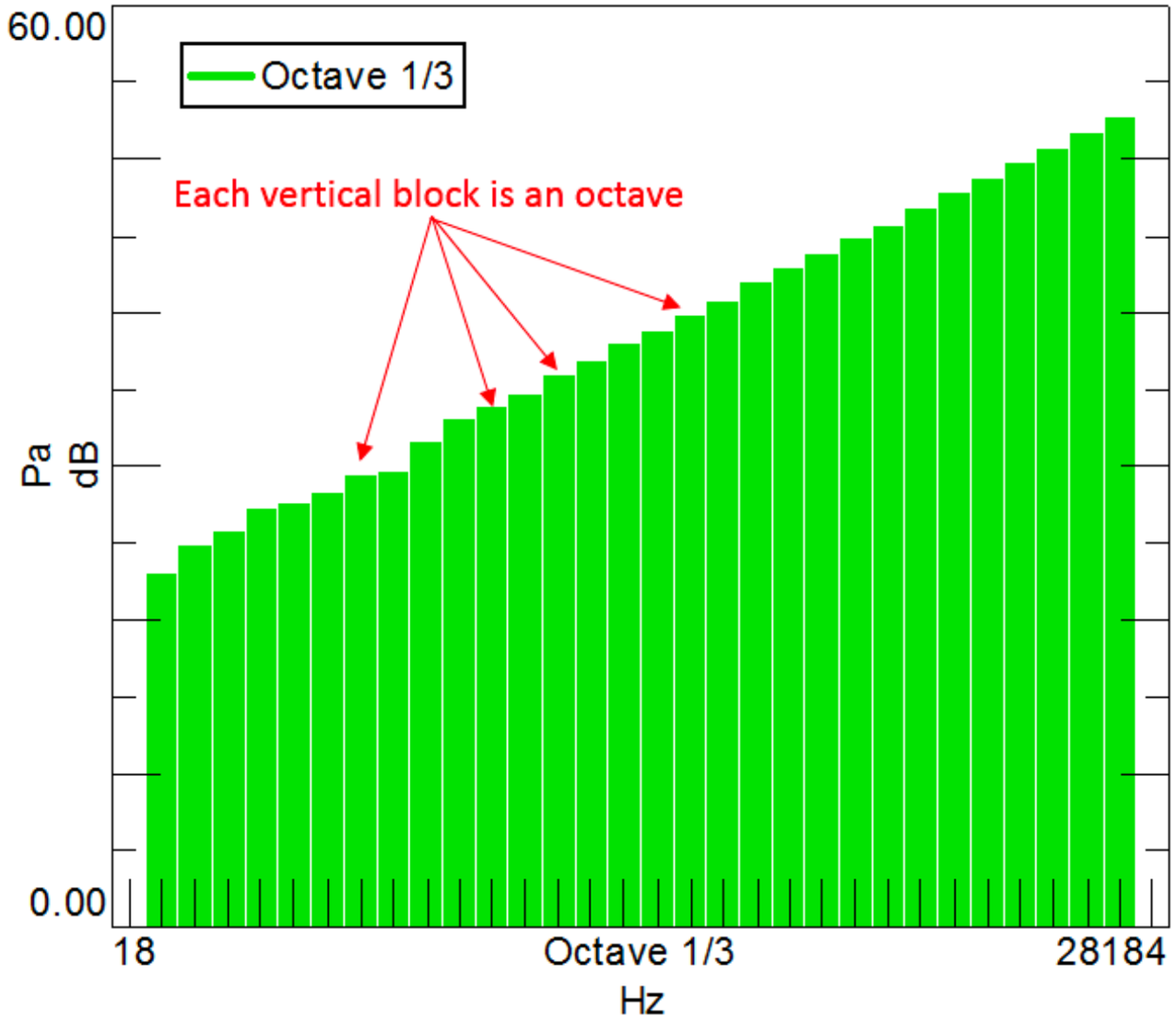
Number	Center frequencies Hz	Cut-off frequencies Hz	Bandwidth Hz
		20	
1	50	100	80
2	150	200	100
3	250	300	100
4	350	400	100
5	450	510	110
6	570	630	120
7	700	770	140
8	840	920	150
9	1000	1080	160
10	1170	1270	190
11	1370	1480	210
12	1600	1720	240
13	1850	2000	280
14	2150	2320	320
15	2500	2700	380
16	2900	3150	450
17	3400	3700	550
18	4000	4400	700
19	4800	5300	900
20	5800	6400	1100
21	7000	7700	1300
22	8500	9500	1800
23	10 500	12 000	2500
24	13 500	15 500	3500

THE BARK SCALE

HEARING

OCTAVES IN HUMAN HEARING

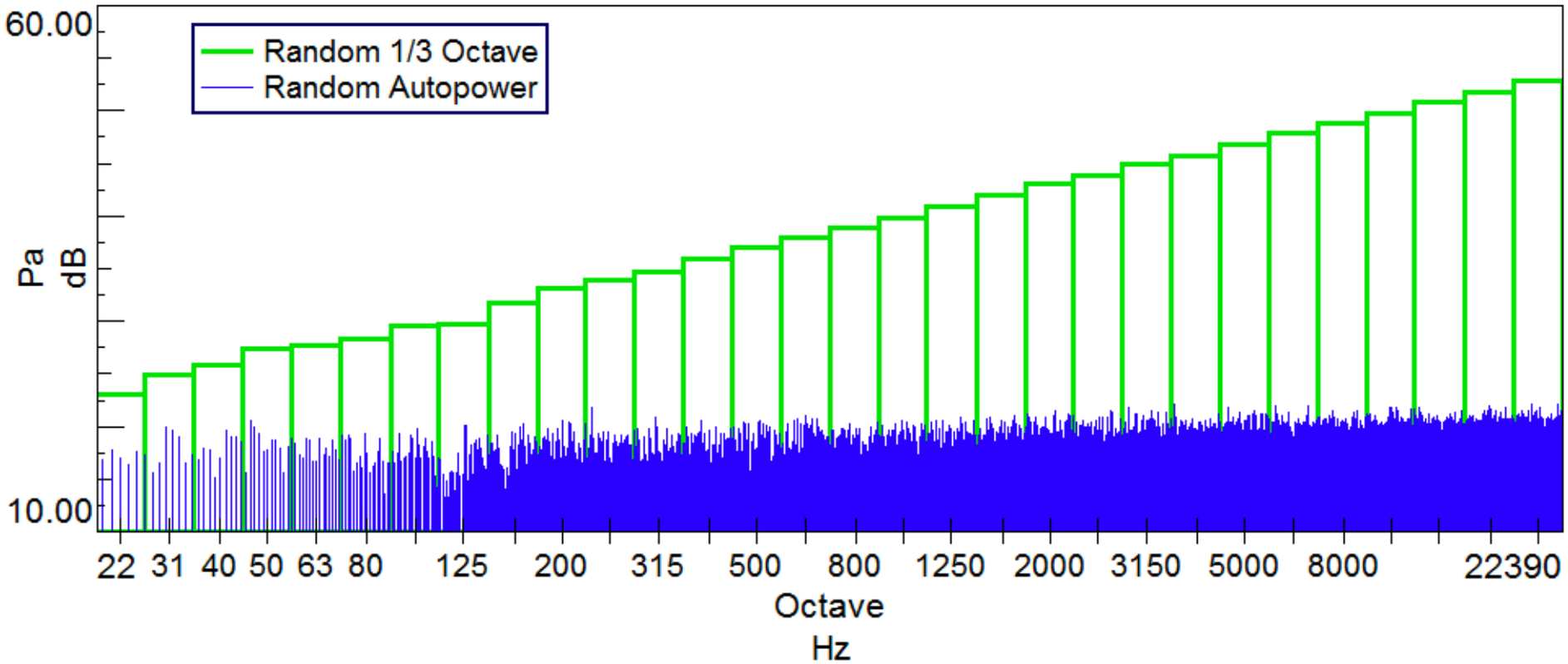
- Higher frequency octaves cover a broader frequency range, compared to lower frequency octaves



OCTAVE MAP FOR HUMAN HEARING

HEARING

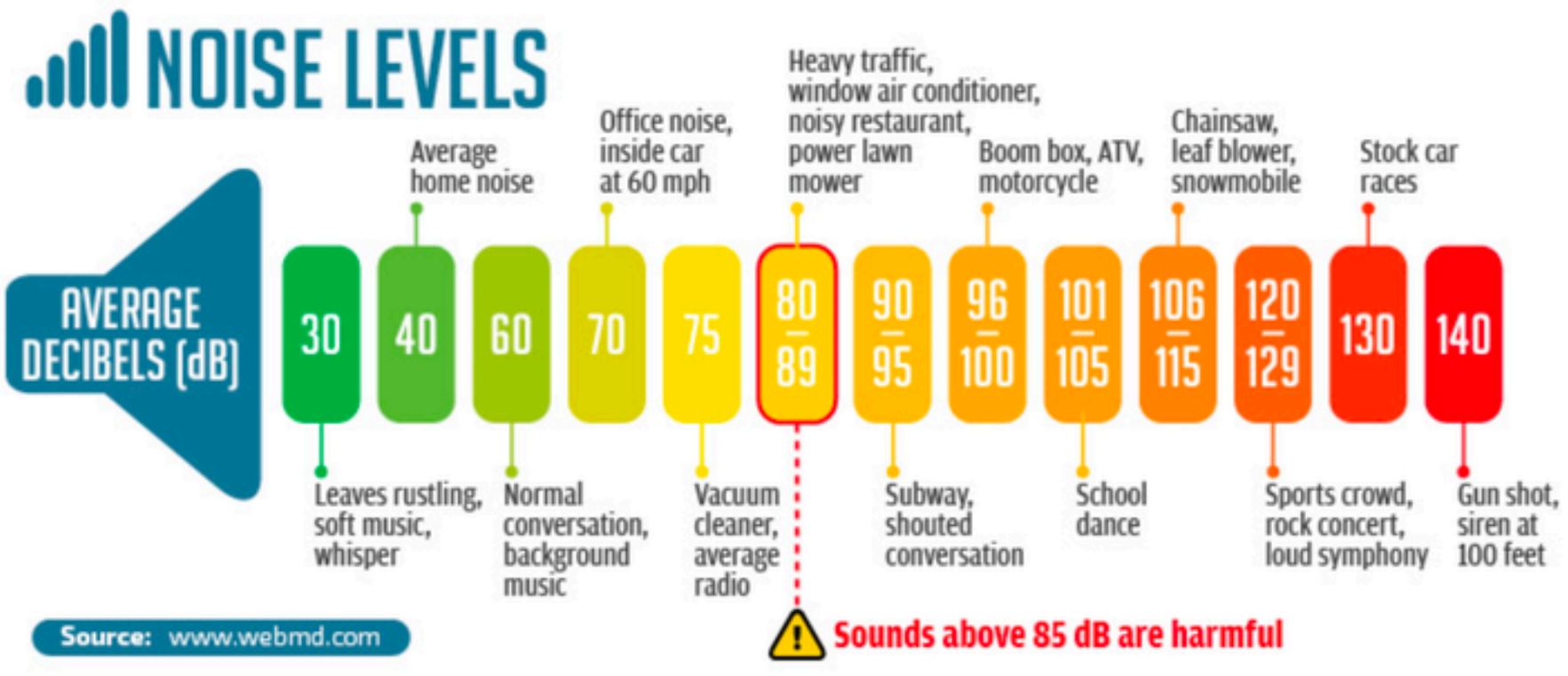
OCTAVES IN HUMAN HEARING



- Higher frequency resolution closer to bass frequencies, lower frequency resolution close to treble frequencies
- At lower frequencies, the ear can more easily distinguish between frequencies
- At higher frequencies, even when the frequencies are somewhat far apart,
    - the ear has difficulty distinguishing between frequencies

HEARING

LEVELS



0 dB - 120 dB

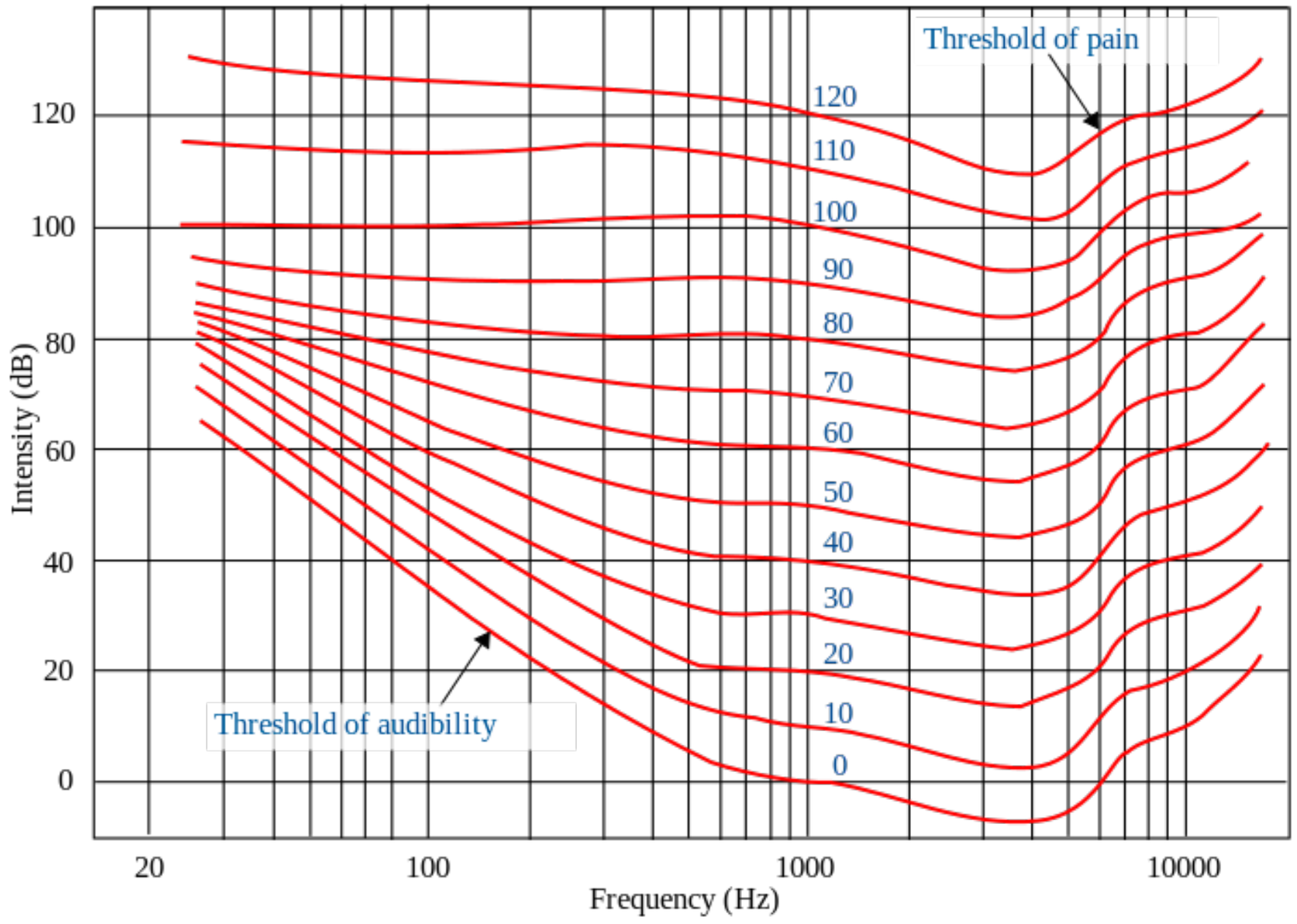
HEARING

LEVELS

- Signal levels are measured in deciBels (**dB**)
  - (- 48 dB) to (6 dB) - Dynamic Range of Audio Signals
- Audible range sounds measured in - **dB SPL**
  - SPL = Sound Pressure Level
  - (0 dB) to (120 dB) - Hearing Range of Human Ears
- Same magnitude in **dB** and **dB SPL** mean different things

HEARING

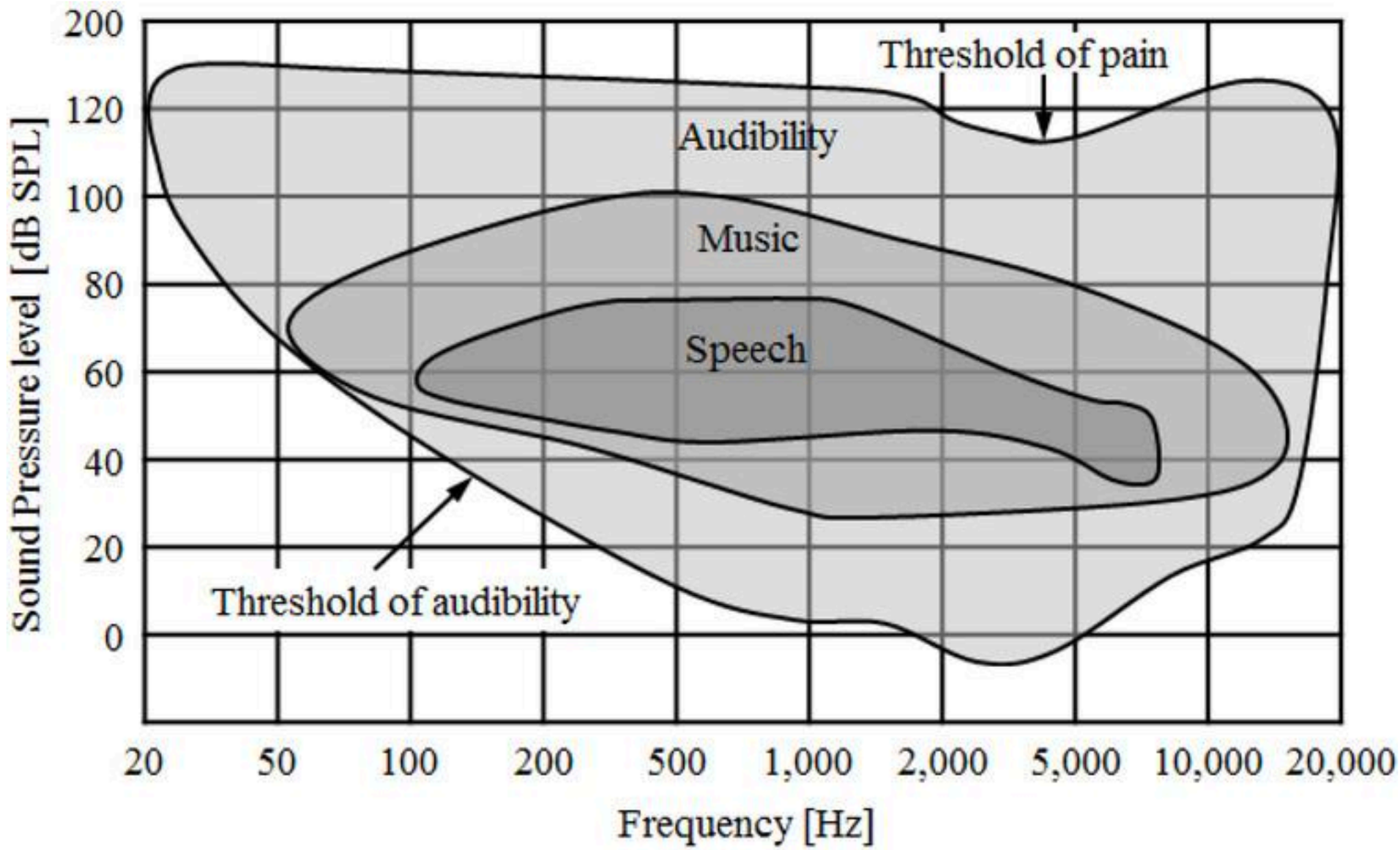
EQUAL LOUDNESS CURVES



ONLY FOR PURE TONES

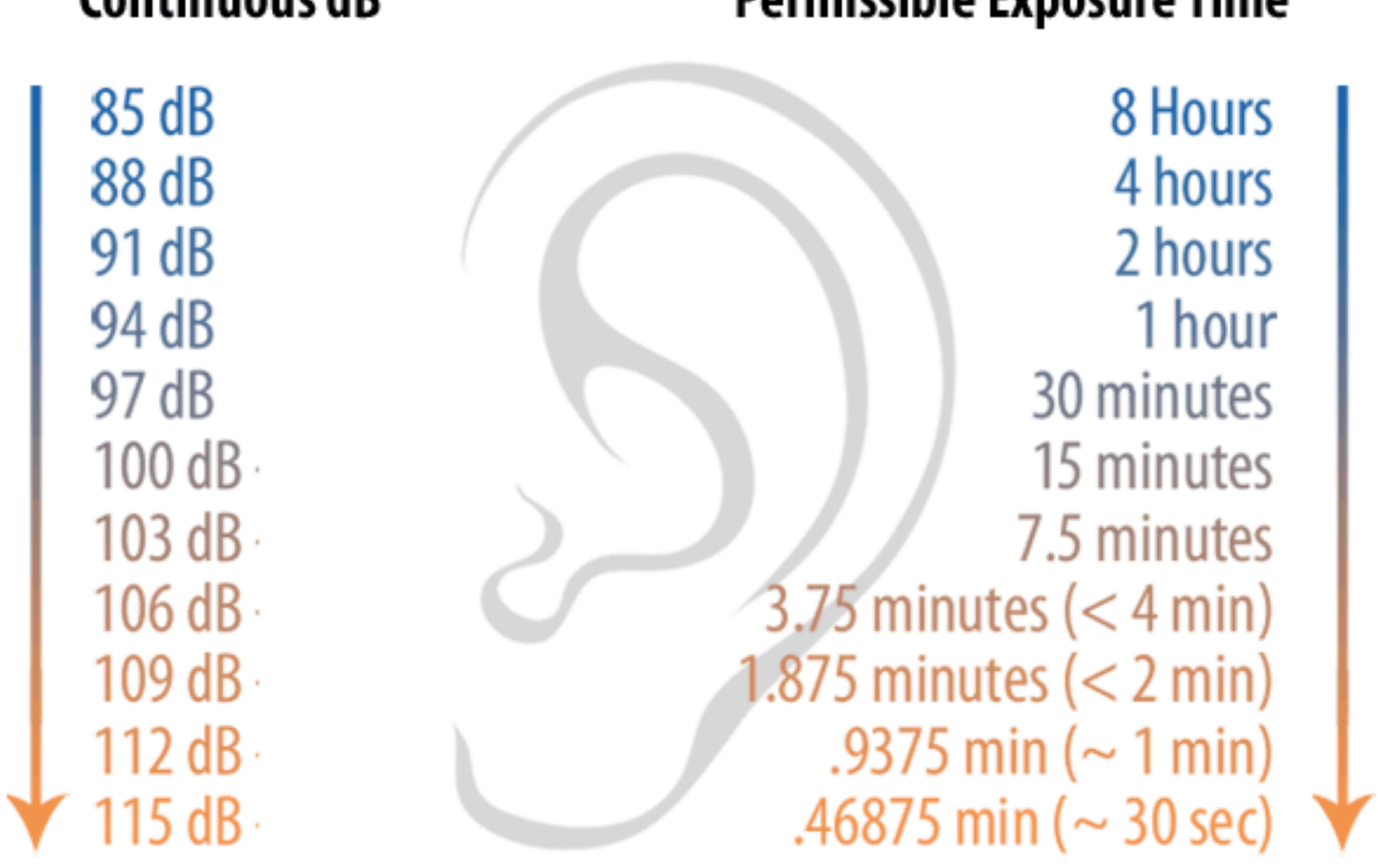
HEARING

HUMAN AUDITORY RANGE



HEARING

EAR DAMAGE IS REAL AND IRREVERSIBLE



HEARING

EAR DAMAGE IS REAL AND IRREVERSIBLE

- **KEY CONCERN**

    - WHEN VOLUME KNOB IS TURNED UP, MORE BASS AND HIGHS ARE PERCEIVED COMPARED TO MIDS

    - BUT THE MID RANGE GETS AMPLIFIED IN THE OUTER EAR CANAL, WHILE OTHERS RANGES GET ATTENUATED

    - LONG TERM BAD HABITS WITH LEVELS CAUSES IRREVERSIBLE DAMAGE

HEARING

EAR DAMAGE IS REAL AND IRREVERSIBLE

- **BEST PRACTISES TO COUNTER EAR DAMAGE**
  - *“forte, ma, non troppo”*
    - LOUD ENOUGH, BUT NOT TOO MUCH
  - MIX THAT SOUNDS GOOD AT QUIET LEVELS SOUNDS GOOD AT LOUD LEVELS
    - BUT THE REVERSE IS NOT TRUE

HEARING

LISTENER'S FATIGUE

- Continued exposure to audio tires out the brain
    - Sound sensation drops with prolonged exposure to high volume

HEARING

LISTENER'S FATIGUE

- More volume is needed to hear the same sound after listening to music for some time
    - Very obvious when working with a piece of music for extended time
- Usually short-term, but may turn chronic
    - Varies from person to person

HEARING

LISTENER'S FATIGUE

- Protect your ears
    - Turning up the volume is a slippery slope
- Stick to one hearing volume level through out production
    - Use tick marks or some other visual identifier to set volume for entire session